AFWL-TR-74-508

AFWL-TR-74-508

ADA008607

DEVELOPMENT OF AN AIR FORCE AIR QUALITY ASSESSMENT MODEL (AQAM)

D. F. Naugle
Capt, USAF, BSC

Air Force Weapons Laboratory
Kirtland Air Force Base, NM 87117

September 1974

Reprint of an Article Published in the ASME Journal
(with permission of copyright owner)

Approved for public release; distribution unlimited.

AIR FORCE WEAPONS LABORATORY
Air Force Systems Command
Kirtland Air Force Base, NM 87117

an ASME publication

[redacted]

Development of an Air Force Air Quality Assessment Model (AQAM)

D. F. NAUGLE

Captain, USAF, BSC

Air Force Weapons Laboratory,
AFSC,
Kirtland AFB, N. M.

The U. S. Air Force, through a contractual effort by Argonne National Laboratory, is developing a computerized Air Quality Assessment Model (AQAM) to better analyze the environmental impact of airbase operations. While most emphasis is placed on improving the accuracy of treating aircraft operations, nearly any municipal or industrial emission source can be analyzed. Emission calculations are performed within the model so that only detailed source activity information must be input. Ambient air quality can be predicted for hourly, daily, monthly, or annual averaging times of up to ten pollutants. This report describes the general capabilities and structure of the AQAM.

Contributed by the Aerospace Division of the American Society of Mechanical Engineers for presentation at the Intersociety Conference on Environmental Systems, Seattle, Washington, July 29-August 1, 1974. Manuscript received at ASME Headquarters April 29, 1974.

Copies will be available until April 1, 1975.

Development of an Air Force Air Quality Assessment Model (AQAM)

D. F. NAUGLE

INTRODUCTION

The primary objective of the U. S. Air Force Air Quality Assessment Model (AQAM) is to predict ground level ambient air quality pollutant concentrations which result from emission sources both within and surrounding Air Force bases. Special emphasis has been given to the accurate description and dispersion of aircraft emissions. However, nearly any urban point, line, or area source can be treated. This model can be applied to at least four different functions:

1 Environmental impact assessments
2 Comparison of predicted concentrations to state and federal air quality standards
3 Prioritizing the significance of emission sources
4 Evaluating potential pollution design criteria for the engineering of control devices.

The AQAM is being developed for the Air Force by Argonne National Laboratory (1).[1] It incorporates many features from previous urban dispersion models. Annual pollution levels can be predicted using stability wind frequency distributions as applied in the widely used Air Quality Display Model (2). Short-term dispersion (1- to 24-hr time averaging) uses the double Gaussian equations as presented in a dispersion workbook by D. Bruce Turner (3). Average urban emission densities can be either directly input or calculated from the average categories as used in the Northern Research and Engineering Corporation Airport Model (4). Automotive emissions are calculated by using segments of the Argonne National Laboratory Transportation Model (5). All line sources, including aircraft, use

[1] Underlined numbers in parenthesis designate References at end of paper.

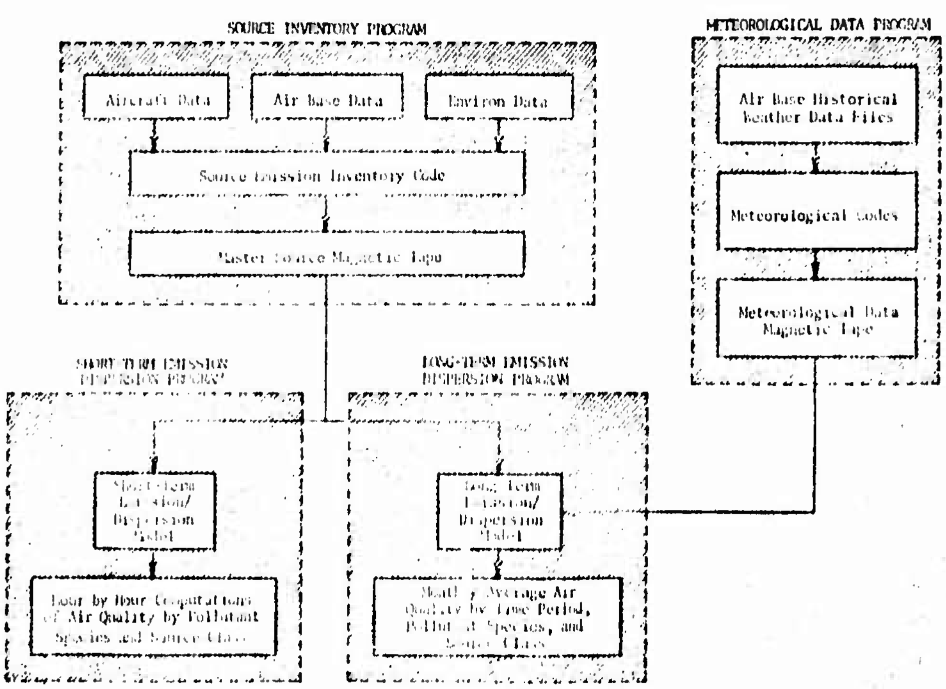

Fig. 1 Overall structure of the AQAM

Table 1 Emission Sources for Air Quality Analysis

AIRCRAFT	GROUND MOBILE	FACILITIES
1. FIXED WING	1. AGE	1. POWER PLANTS
2. HELICOPTER	A. GENERATORS (2 TYPES)	2. INCINERATORS (PATHOLOGICAL)
	B. HEATERS	3. INCINERATORS (WOOD & PAPER)
	C. COOLERS	4. AIRCRAFT FUELING FACILITIES.
	D. ENGINE STARTERS	5. CAR & TRUCK FUELING FACILITY.
	E. HYDRAULIC TEST STANDS	6. TANK TRUCK LOADING UNLOADING.
	F. LIGHT CARDS	7. DISTRIBUTION TANK
	G. COMPRESSORS	8. STORAGE TANKS
	H. TURBINE AGE EQUIPMENT	9. HEATING PLANTS
	I. OTHER	A. AIRMEN DORMITORY
	2. LIGHT DUTY VEHICLES MILITARY	B. BOQ
		C. FAMILY HOUSING
	3. LIGHT DUTY VEHICLES CIVILIAN	10. TEST CELLS
		11. RUN UP STANDS
	4. TRUCKS	12. INDUSTRIAL FACILITIES
	5. OFF ROAD VEHICLES	13. TRAINING FIRES

the Argonne Line Source Model (6).

Unique features of the AQAM include very detailed algorithms to accurately describe aircraft operations. Aircraft emissions are not grouped into generalized categories (e.g., aircraft with over 400,000 lb gross weight). Instead, engine mission factors, aircraft landing and take-off (LTO) cycle times, runway roll distances, take-off profiles, and approach profiles are all treated specifically for the particular aircraft types of interest. Also, atmospheric conditions are treated in more detail by the AQAM than by previous long-term dispersion models.

GENERAL DESCRIPTION OF MODEL

The AQAM presently has four functional elements as presented in Fig. 1. The Source Inventory Program accepts operational input data and computes the true annual mean emissions for each source. This output alone is very useful and may be adequate for many environmental impact assessments without any further dispersion analysis. When dispersion calculations are needed, this true annual mean emission is adjusted to the actual monthly, weekly, and daily time period emission rate for use in the Short-Term or Long-Term Dispersion Model.

Operational input to the Source Inventory Program is broken into three categories as shown in Fig. 1. AIRCRAFT DATA includes all emissions directly related to operations of the aircraft. Aircraft taxi, landings, take-offs, fuel venting, and ground support equipment are examples. AIRBASE DATA includes all emission sources within the confines of the airbase which are in the aircraft operations category. Examples are jet engine test cells, power plants, heating plants, military industrial operations, vehicular operations, and space heating of buildings. ENVIRONS are defined as all emission sources outside the airbase. Examples are municipal power plants, civilian industry, and civilian vehicles.

The Short-Term Dispersion Program calculates air quality by using hour by hour meteorological input data. Computations can be averaged for time periods up to 24 hr. This allows direct comparisons to federal ambient air quality standards (which may be specified for a 1-, 3-, 8-, or 24-hr averaging basis, depending on the pollutant type).

Table 2 Source Inventory Output for Aircraft

T 38 AIRCRAFT - ANNUAL EMISSIONS (METRIC TONS/YEAR)

OPERATION	CO	HC	NOX	PM	SOX
STARTUP	5.646E+02	1.595E+02	2.013E+01	1.139E+02	1.519E+00
TAXI OUT	1.0[illegible]E+03	3.026E+02	3.816E+01	2.161E+02	2.882E+00
ENGINE CHECK	4.730E+01	5.927E+00	5.518E+00	1.322E+01	4.087E-01
RUNWAY ROLL	8.457E+01	9.677E+00	7.500E+00	1.216E+01	9.677E-01
CLIMB 1	7.047E+01	8.354E+00	6.242E+00	1.057E+01	8.054E-01
CLIMB 2	1.440E+02	1.315E+01	1.690E+01	3.133E+01	1.252E+00
APPROACH 1	1.066E+02	2.603E+01	9.970E+00	5.539E+01	1.108E+00
APPROACH 2	1.242E+02	2.578E+01	6.692E+00	3.736E+01	6.811E-01
LANDING	1.3[illegible]E+02	3.605E+01	4.831E+00	2.718E+01	3.624E-01
TAXI IN	8.609E+02	2.433E+02	3.970E+01	1.738E+02	2.317E+00
SHUTDOWN	2.946E+01	7.975E+00	1.006E+00	5.590E+00	7.595E-02
ARR + DEP SV	7.234E+00	1.153E+02	2.473E+00	1.191E+01	4.637E-01
FUEL VENTING	0.	1.195E+02	0.	0.	0.
FILL + SPILL	0.	2.551E+02	0.	0.	0.
TOUCH + GO	7.565E+02	1.180E+02	5.978E+01	1.962E+02	5.839E+00
TOTAL	4.053E+03	1.470E+03	2.099E+02	9.032E+02	1.868E+01

TRANSENT

Table 3 Source Inventory Summary Output

SUMMARY OF ANNUAL EMISSIONS (METRIC TONS/YEAR)

OPERATION	CO	HC	NOX	PM	SOX
AIRCRAFT	7.096E+03	2.603E+03	4.396E+02	1.781E+03	3.694E+01
GROUND MOBIL	3.587E+03	3.997E+02	3.496E+02	2.711E+01	1.363E+01
FACILITIES	5.629E+02	1.465E+02	3.041E+02	1.708E+02	3.247E+00
ENVIRONS	0.	0.	0.	0.	0.
GRAND TOTAL	1.125E+04	3.149E+03	1.093E+03	1.979E+03	5.383E+01

PERCENT OF EMISSIONS FROM ALL SOURCES

OPERATION	CO	HC	NOX	PM	SOX
AIRCRAFT	63.097	82.654	40.208	90.001	68.637
GROUND MOBIL	31.898	12.693	31.976	1.370	25.330
FACILITIES	5.005	4.653	27.816	8.630	6.033
ENVIRONS	0.000	0.000	0.000	0.000	0.000

The Long-Term Dispersion Program utilizes extensive climatological data from the Meteorological Data Program and emissions from the Source Inventory Program to produce monthly, seasonal, or annual average ambient concentrations. Averages can also be performed for one of several daily time periods (e.g., annual average air quality for the time period 0600 to 0900 can be calculated). Analysis can be done for all pollutants, but is especially important for oxides of Nitrogen which presently only have an annual ambient air quality standard.

The Meteorological Data Program produces a meteorological data tape (for input to the Long-Term Dispersion Program). The data tape consists of specialized climatological data categorized by diurnal time periods on a monthly and annual basis. This is a unique feature of AQAM which is presently undergoing a value analysis.

SOURCE INVENTORY PROGRAM

Manually calculating a total emission inventory can be a tedious procedure. This is particularly true for aircraft which have highly variable engine emission characteristics and many engine modes throughout the landing and take-off cycle. This Source Inventory Program was, therefore, designed to contain data banks of emission

information. Total emissions are then calculated when given only source activity information from a field survey. Jet engine test cell emissions, for example, can be calculated by knowing only the type of aircraft engines tested and the operating times in each engine mode.

The Holland (7) and Carson-Moses (8) plume rise relationships are programmed into the computer code for optional usage. Either can be used with input information of stack height, stack exit temperature, gas exit velocity, stack diameter, and building height.

Examples of typical emission sources on an Air Force Base are shown in Table 1. Aircraft are given an area source geometry at the parking ramp, and line geometries for taxi, take-off, climb-out, approach, and landing. Coordinates of all area and line sources must be input. Aerospace Ground Equipment (AGE) are considered area sources while vehicles can have either a line or area source geometry. Facilities can be treated as having point, line, or area source emission geometries. Also, any sources not specifically programmed can be added without computer code changes by the use of NAMELIST input statements.

Sample source inventory computer outputs for aircraft is presented in Table 2. Similar outputs are generated for each aircraft type and for totals of all aircraft. All components related to the aircraft LTO cycle are listed separately so that the effects of any pollution control strategies can be readily analyzed. Similar types of summary charts are also automatically printed for all AIRBASE and ENVIRON emission sources.

Computer output summary tables of all previous source calculations are shown in Table 3. Total annual emissions are given for up to ten pollutants of interest. The percent of each source category toward the total is also calculated.

SHORT-TERM DISPERSION PROGRAM

The Short-Term Dispersion Program is used to predict air quality concentrations resulting from specifically input meteorological conditions. These predictions are important when assessing the impact of sources releasing acutely toxic substances, such as carbon monoxide, or when comparing predicted results with limited ambient air quality measurements.

The first task of this program is to read in the Source Inventory tape containing the calculated true annual mean emissions for each source. These annual mean emissions are then

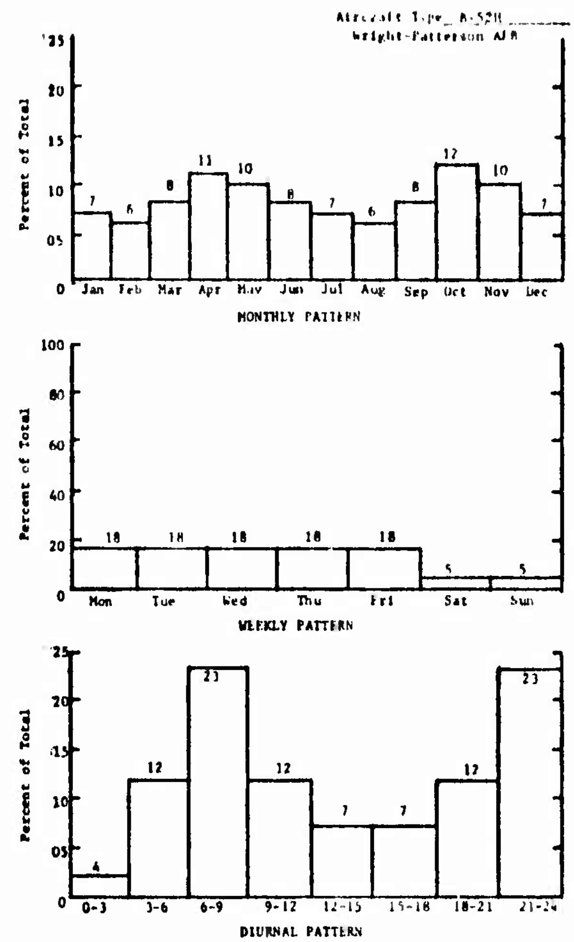

Fig. 2 Example of activity pattern information

adjusted to the specific time period of interest. For example, most military aircraft have decreased flying activities during weekends and after darkness. Inaccuracies would result from simply dividing the true annual emissions by the total number of hours per year to get an hourly emission rate. Activity patterns as graphically shown in Fig. 2 are, therefore, input into the Short-Term Program and emissions are automatically calculated for the particular month, day, and hour of interest. By programming activity patterns, which are usually available from past records, the logistical problem of recalculating total emissions for each time period is avoided. Without activity patterns, emissions rates would have to be broadly categorized (e.g., emissions per weekday). This would minimize calculations but also introduce inaccuracies.

The next task of the Short-Term Program is to process the hourly input of specific meteorological conditions. Atmospheric stabilities (9), wind speed, wind direction, temperature, and mixing depth are input and can be changed on an hourly basis.

Table 4 Short-Term Summary Output

WILLIAMS AFB SHORT TERM MODEL RUN NUMBER 1
MONTH = JAN PERIOD = [illegible] TO [illegible] HOURS ON A WEEKDAY

RECEPTOR CONCENTRATION DATA FROM AIRCRAFT SOURCES							
RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS)		EXPECTED ARITHMETIC MEAN (MICROGRAMS/CU. METER)				
	X	Y	CO	HC	NOX	PT	SO2
38	-4.00	4.00	6.155E+02	2.821E+02	2.271E+01	1.2[illegible]E+02	1.761E+00
39	-4.00	6.00	5.393E+02	2.463E+02	1.989E+01	1.[illegible]E+02	1.543E+00
40	-4.00	8.00	6.033E+02	2.436E+02	2.234E+01	1.218E+02	1.745E+00
41	-2.00	-10.00	0.	0.	0.	0.	0.
42	-2.00	-8.00	0.	0.	0.	0.	0.
43	-2.00	-6.00	0.	0.	0.	0.	0.
44	-2.00	-4.00	4.757E+01	5.999E+00	5.589E+00	1.034E+01	4.137E-01
45	-2.00	-2.00	3.433E+03	1.428E+03	1.251E+02	6.974E+02	9.714E+00
46	-2.00	0.00	2.246E+03	1.059E+03	8.184E+01	4.552E+02	5.331E+00
47	-2.00	2.00	1.144E+03	5.282E+02	4.192E+01	2.323E+02	3.252E+00
48	-2.00	4.00	8.033E+02	3.673E+02	2.953E+01	1.632E+02	2.290E+00
49	-2.00	6.00	8.103E+02	3.371E+02	3.013E+01	1.633E+02	2.341E+00
50	-2.00	8.00	6.508E+02	2.698E+02	2.444E+01	1.312E+02	1.929E+00
51	0.00	-10.00	0.	0.	0.	0.	0.
52	0.00	-8.00	0.	0.	0.	0.	0.
53	0.00	-6.00	0.	0.	0.	0.	0.
54	0.00	-4.00	0.	0.	0.	0.	0.
55	0.00	-2.00	4.704E+01	6.605E+00	5.592E+00	1.036E+01	4.142E-01
56	0.00	0.00	3.443E+03	1.432E+03	1.255E+02	6.992E+02	9.740E+00
57	0.00	2.00	2.246E+03	1.060E+03	8.192E+01	4.505E+02	6.358E+00
58	0.00	4.00	1.331E+03	5.803E+02	4.374E+01	2.037E+02	3.730E+00
59	0.00	6.00	9.472E+02	4.352E+02	3.340E+01	1.912E+02	2.632E+00
60	0.00	8.00	5.337E+02	2.801E+02	2.359E+01	1.234E+02	1.651E+00
61	2.00	-10.00	0.	0.	0.	0.	0.
62	2.00	-8.00	0.	0.	0.	0.	0.
63	2.00	-6.00	0.	0.	0.	0.	0.
64	2.00	-4.00	0.	0.	0.	0.	0.
65	2.00	-2.00	0.	0.	0.	0.	0.
66	2.00	0.00	4.770E+01	6.012E+00	5.600E+00	1.037E+01	4.148E-01
67	2.00	2.00	3.563E+03	1.467E+03	1.297E+02	7.233E+02	1.036E+01
68	2.00	4.00	2.375E+03	1.092E+03	8.770E+01	4.838E+02	6.837E+00
69	2.00	6.00	1.149E+03	5.294E+02	4.225E+01	2.332E+02	3.293E+00
70	2.00	8.00	7.959E+02	3.654E+02	2.927E+01	1.617E+02	2.270E+00
71	4.00	-10.00	0.	0.	0.	0.	0.
72	4.00	-8.00	0.	0.	0.	0.	0.
73	4.00	-6.00	0.	0.	0.	0.	0.
74	4.00	-4.00	0.	0.	0.	0.	0.

Dispersion calculations can now be done since the specific source emission and dispersion conditions are known. Computations are done for each of several thousand possible sources, and the results are summed at each of 300 possible receptors. Ambient concentrations at each receptor are calculated for three categories — AIRCRAFT, AIRBASE, and ENVIRONS — so that pollution contributions for each category can be identified.

The final task of the Short-Term Program is to output the data in a usable format. Results can be printed hourly or averaged over 3-, 8-, or 24-hr periods. An example of the tabular output is shown in Table 4. Similar tables are produced for AIRCRAFT, AIRBASE, ENVIRONS, and TOTAL. Results can also be plotted for graphical presentation.

LONG-TERM DISPERSION PROGRAM

The Long-Term Program performs many more calculations than the Short-Term Program. Calculations to determine the contribution of each source to the many receptors must be done separately for 16 wind directions, six wind speed classes, and five atmospheric stability conditions. Well over 1 billion computations can be required. These are all in addition to the data storage, data conversion, summation routines,

and other "bookkeeping" procedures to produce the output in a meaningful format. A central Memory Unit Core Storage capacity of 300,000, 60-bit words on the CDC 6600 computer are typically used.

Several user options can be utilized in the Long-Term Program so that adequate analyses can be performed but unnecessary computations are avoided. The simplest case is to request only the arithmetic annual mean concentrations for the total 24-hr period within each day. If more specific predictions are desired, they can be made separately for each month of the year. Diurnal patterns can also be readily analyzed by making monthly predictions in any of the following daily time periods:

1 0000 thru 2400 (all day)
2 0600 thru 1800 (daylight hours)
3 0600 thru 0900 (peak traffic hours)
4 0900 thru 1500 (major working hours)
5 1500 thru 1800 (afternoon traffic hours)
6 1800 thru 2100 (nightly inversion formation)
7 2100 thru 0600 (overnight hours).

Only the specific meteorological conditions and emission rates will be used within each of the foregoing time periods of interest.

The ability of the Long-Term Dispersion Program to utilize the diurnal patterns of both meterology and emissions is another unique feature of AQAM. An annual or monthly average can be made using time periods 3 thru 7. An average formed in this manner should give results considerably closer to reality than one using daily average emissions and meteorological conditions. For example consider the fact that ambient concentrations (X) result in the atmosphere by the dispersion of emissions (Q). Therefore,

$$X = f(Q) \tag{1}$$

The atmosphere's dispersive ability is represented by the function "f." Since both "Q" and "f" are strongly dependent on the time of day, the resulting mean concentration ($\bar{X}$) for a daily period is more accurately calculated by:

$$\bar{X}_{\text{per day}} = \sum_{1}^{n} \frac{f_1(Q_1) + F_2(Q_2) + \ldots F_n(Q_n)}{n} \tag{2}$$

Rather than the commonly used method of:

$$\bar{X}_{\text{per day}} = \bar{f}_{\text{per day}}\,(\bar{Q})_{\text{per day}} \tag{3}$$

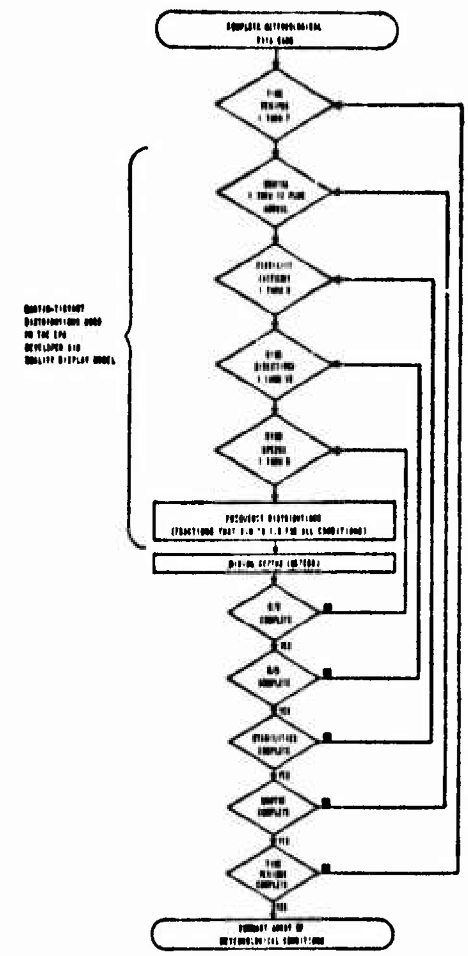

Fig. 3 Meteorological data program schematic

The accuracy improvements by using this technique have not yet been quantified. Argonne National Laboratory is presently investigating this difference using AQAM. They are comparing long-term air quality predictions in the Chicago area using the five daily time periods to those made using single daily means of emissions and meteorological conditions. The results will then be compared to actual air quality data.

The output of the Long-Term Dispersion Program is in exactly the same format as for the Short-Term Program. Isopleth contours (equal pollution lines) of the Long-Term results are especially significant because winds from all directions have been considered. The resulting isopleths often have considerably different patterns than those of a wind rose. This is due to the effects of different atmospheric stabilities and wind speeds on the dispersion of pollution sources which are elevated above ground level.

METEOROLOGICAL DATA PROGRAM

To supply climatological information required by the Long-Term Dispersion Program, a computer tape of meteorological data must be compiled specifically for each location of interest. These tapes are compiled from data which is stored at the National Climatic Center, National Oceanic and Atmospheric Administration (NOAA), Asheville, North Carolina. Past records of periods between 5 and 20 years are typically available. The Meteorological Data Program described in this section is being operated for Air Force agencies by the USAF Environmental Technical Applications Center (ETAC), Washington, DC.

Information is structured to first give the average annual conditions as follows:

1 Average temperature (deg F)
2 Average number of degree days (days · deg F)
3 Average pressure (millibars)
4 Average pressure altitude (100 ft)
5 Average wind speed (m/sec)
6 Average daily temperature variation (deg F)
7 Average afternoon maximum depth (m).

Data is then categorized into daily time intervals of: 0000 thru 2400, 0600 thru 1800, 0600 thru 0900, 0900 thru 1500, 1500 thru 1800, 1800 thru 2100, 2100 thru 0600. Within each of these time periods, data is stratified according to the following scheme in Fig. 3. The widely used Martin-Tikvart frequency distributions (10) compute average mixing depths over the entire period. Greater accuracy should be obtained by using this array which varies mixing depth as a function of wind speed, stability, diurnal time period, and month. The degree of this accuracy improvement is currently being studied in a sensitivity analysis of the model.

REFERENCES

1 Wangen, L. E., and Rote, D. M., A Generalized Air Quality Assessment Model-A User's Manual, Argonne National Laboratory, Air Force Weapons Laboratory Report TR-74-56, March 1974.

2 Air Quality Display Model, TRW Systems Group, Washington, D. C., Distributed by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va., Accession Number, PB-189194, Nov. 1969.

3 Turner, D. B., Workbook of Atmospheric Dispersion Estimates, Public Health Service Publication No. 999-AP-26, 1970.

4 The Potential Impact of Aircraft Emissions on Air Quality, Report No. NREC 1167-1, Northern Research and Engineering Corporation, Cambridge, Mass., Dec. 29, 1971.

5 Cirillo, R. K., and Walsko, T. D., Handbook of Air Pollutant Emissions from Transportation Systems, Argonne National Laboratory Report No. ANL/ES-28, Sept. 1973.

6 Wang, I. T., and Rote, D. M., "A Finite Line Source Dispersion Model for Mobile Source Air Pollution," Paper 73-135, 66th Air Pollution Control Association, Chicago, Ill., June 24, 1968.

7 Briggs, G. A., Plume Rise, U. S. Atomic Energy Commission, Division of Technical Information, 1969.

8 Moses, H. and Carson, J. E., "Stack Design Parameters Influencing Plume Rise," Paper 67-84, 60th Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio, 1967.

9 Turner, D. B., "A Diffusion Model for an Urban Area," Journal of Applied Meteorology, Vol. 3, No. 1, Feb. 1964.

10 Martin, D. O. and Tikvart, J. A., "A General Atmospheric Diffusion Model for Estimating the Effects on Air Quality of One or More Sources," Air Pollution Control Association Paper, June 1968.

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: (14) AFWL-TR-74-508
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER: (9) Technical rept.
4. TITLE (and Subtitle): (6) Development of an Air Force Air Quality Assessment Model (AQAM).
5. TYPE OF REPORT & PERIOD COVERED
6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): (10) Captain D. F./Naugle
8. CONTRACT OR GRANT NUMBER(s): (11) 29 Apr 74
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Air Force Weapons Laboratory, Kirtland AFB, NM 87117
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (12) 11p.
11. CONTROLLING OFFICE NAME AND ADDRESS: Air Force Weapons Laboratory, Kirtland AFB, NM 87117
12. REPORT DATE: September 1974
13. NUMBER OF PAGES: 8
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): Same as block 11.
15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report): Approved for public release; distribution unlimited.
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report): Same as block 16.
18. SUPPLEMENTARY NOTES
19. KEY WORDS (Continue on reverse side if necessary and identify by block number):
air pollution
aircraft pollution
environics
civil engineering
dispersion model

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The U. S. Air Force, through a contractual effort by Argonne National Laboratory is developing a computerized Air Quality Assessment Model (AQAM) to better analyze the environmental impact of airbase operations. While most emphasis is placed on improving the accuracy of treating aircraft operations, nearly any municipal or industrial emission source can be analyzed. Emission calculations are performed within the model so that only detailed source activity information must be input. Ambient air quality can be predicted for hourly, daily, monthly, (over)

DD FORM 1473, 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

-rom 1473A

ABSTRACT (Cont'd)

or annual averaging times of up to ten pollutants. This report describes the general capabilities and structure of the AQAM.

1473B